

CENTRIFUGAL PUMP

BACKGROUND OF THE INVENTION

This invention relates to a centrifugal pump comprising a centrifugal impeller having an inlet substantially similar in configuration to that of an axial impeller.

Generally, an axial impeller has the low head and its specific speed N_s is usually higher than 1000 ($m^3/min, rpm, m$). The state of the art is such that it is impossible for design technology now available to produce an axial impeller having the high head or having its specific speed N_s as low as 200.

SUMMARY OF THE INVENTION

This invention has been developed for the purpose of obviating the aforesaid disadvantage of the prior art. Accordingly, the invention has as its object the provision of a centrifugal pump comprising a centrifugal impeller which, although its inlet is substantially similar in configuration to that of an axial impeller, has the high head.

According to the invention, there is provided a centrifugal pump comprising a casing, a stationary guide vane secured to the casing, and a centrifugal impeller arranged for rotation in the casing in a position adjacent the stationary guide vane, said centrifugal impeller including a hub in the form of frusto-cone and at least one blade wound in convolutions on a peripheral surface of the hub and having a blade inlet surface substantially perpendicular to the axis of rotation of the impeller and a fluid flow entrance surface substantially parallel to said blade inlet surface, said blade being wound in a suitable number of convolutions extending from an inlet to an outlet on the hub and being forwardly inclined toward the axis of rotation of the impeller at an increasingly greater angle in going from the inlet toward the outlet so as to generate centrifugal forces at the outlet, the angle of inclination of the blade with respect to the axis of rotation of the impeller being arbitrarily selected from the range between 0 and 90 degrees.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of a centrifugal impeller having a single blade according to the invention;

FIG. 2 is a vertical sectional view taken along the line II—II in FIG. 1;

FIG. 3 is a front view of a centrifugal impeller having two blades according to the invention;

FIG. 4 is a vertical sectional view taken along the line IV—IV of FIG. 3;

FIG. 5 is a vertical sectional view of the centrifugal pump comprising one embodiment of the invention in which the single blade centrifugal impeller shown in FIGS. 1 and 2 is incorporated;

FIG. 6 is characteristic curves of the centrifugal pump according to the invention based on the results of experiments;

FIG. 7 is a fragmentary sectional view taken along the line VII—VII in FIG. 5;

FIG. 8 is a fragmentary sectional view of the stationary guide vane taken along the line VIII—VIII in FIG. 7; and

FIG. 9 is a perspective view of the centrifugal impeller of the double blade type according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIGS. 1 and 3 show a centrifugal impeller 10 having an axis of rotation 14 comprising a single blade 16 which is wound in more than one convolution.

The actual blade inlet of the centrifugal impeller 10 is indicated by a straight line 12, and the portion of the blade 16 extending from the blade inlet 12 to the right as viewed in the drawing of FIG. 1 and merging into the peripheral surface of a hub 18 of the impeller 10 is only an inlet guide for fluid and does not operate as a blade. Practically, the portion of the blade 16 extending spirally counter-clockwise from the blade inlet 12 to a blade outlet 16a (FIG. 2) operates as a blade. The surface which is formed by the blade inlet 12 when the impeller 10 rotates is a blade inlet surface 12a. Therefore the blade 16 has the inlet surface 12a which works to scoop up a cylindrical fluid flow when the impeller rotates, the configuration of the inlet surface 12a is nearly perpendicular to the axis of rotation 14, and a fluid flow entrance is substantially parallel to said blade inlet surface 12a. The blade 16 of this configuration is formed on the peripheral surface of the hub 18 in more than one convolution from its inlet 12 to the outlet 16a. The blade 16 is inclined forwardly toward the axis of rotation 14 at an increasingly greater angle in going from the blade inlet 12 toward the blade outlet 16a, so that the hub 18 is frusto-conical in shape and has its diameter increase in going from the blade inlet 12 toward the blade outlet 16a. The angle of inclination of the blade 16 may be arbitrarily selected from the range between 0 and 90 degrees with respect to the axis of rotation 14. Convolution of the blade 16 define on the hub 18 the fluid channel 20 which is nearly equal in area in any cross section.

FIGS. 3 and 4 show a centrifugal impeller having two blades 32 and 34 according to the invention. Convolution of the blades 32 and 34 define on the hub 35 fluid channels 36 and 37 extending from blade inlets 38 and 40 to blade outlets and configured nearly equal in area in any cross section. The blades 32 and 34 each are determined in a length such that they have more than one-half convolutions to define the fluid channels 36 and 37. When the impeller has two or three blades, it has the higher head than the impeller of the single blade type.

Although the centrifugal impeller according to the invention is similar in the configuration of its inlet to an axial impeller, the fluid inlet angle is not as great as the incidence angle of an axial impeller. The generated head of an axial impeller is low, but the centrifugal impeller according to the invention has the high head in spite of the configuration of its inlet being substantially similar to that of an axial impeller.

The blade of the impeller according to the invention is somewhat similar in contour (the length of the blade) to the blade of an inducer located in the suction of a centrifugal pump of the prior art. However, the blade of the prior art is basically that of an axial impeller and its head is low. The blade of the impeller according to the invention is also similar in contour to a non-clogging single blade of the prior art. However, the blade of the prior art is distinct in the configuration of its inlet from the blade of the impeller according to the invention.

FIG. 5 shows a centrifugal pump 50 incorporating therein the impeller 10 of the single blade shown in FIG. 1. The centrifugal pump 50 comprises a casing 52